

infer that the risk of smoking-related cancer for sites other than the lungs would increase, at a given adult age, in inverse proportion to the age an adolescent begins smoking.

Recent studies indicate that earlier onset of cigarette smoking is also associated with heavier smoking (Taioli and Wynder 1991; Escobedo et al. 1993).

Heavier smokers are not only more likely to experience tobacco-related health problems, they are the least likely to quit smoking (Hall and Terezhalmay 1984; USDHHS 1989). Early use of cigarettes thus appears to influence intensity as well as duration of use and increases the potential for long-term health consequences.

Nicotine Addiction in Adolescence

Introduction

Nicotine dependency through cigarette smoking is not only the most common form of drug addiction but the one that causes more death and disease than all other addictions combined (USDHHS 1988). Most human research on nicotine addiction has been conducted with adult subjects, but the basic biologic processes that underlie this dependency appear to be similar in adolescents and adults. The research literature on nicotine addiction examines its chemistry and addiction potential, its severity, and its pathophysiology and clinical course.

Background and Nomenclature

Drug addiction is the term most widely used to label various medical and social disorders related to the compulsive ingestion of psychoactive chemicals. The primary criteria for drug dependence are that the behavior is highly controlled or compulsive, the chemical is one whose mood-altering or psychoactive effects are central elements of the drug's activity, and the drug itself has the demonstrated capability of reinforcing behavior (Table 4). The American Psychiatric Association (APA) has identified two medical disorders that pertain to nicotine addiction: nicotine dependence and nicotine withdrawal (APA 1987).

Nicotine dependence is classified as a psychoactive substance-use disorder characterized by "a cluster of cognitive, behavioral, and physiologic symptoms that indicate that the person has impaired control of psychoactive substance use and continues use of the substance despite adverse consequences" (APA 1987, p. 166). In the case of nicotine, the most common form of use is cigarette smoking, in part because the rapid absorption of nicotine through the processes of smoking "leads to a more intensive habit pattern that is more difficult to give up" than other forms of use (APA 1987, p. 181). Nicotine dependence also occurs through other routes of delivery, including smokeless tobacco and nicotine gum.

Nicotine withdrawal, an organic mental disorder induced by the removal of psychoactive substance, is described as "a characteristic withdrawal syndrome due to the abrupt cessation of or reduction in the use of nicotine-containing substances (e.g., cigarettes, cigars and pipes, chewing tobacco, or nicotine gum) that has been at least moderate in duration and amount. The syndrome includes craving for nicotine; irritability, frustration, or anger; anxiety; difficulty concentrating; restlessness; decreased heart rate; and increased appetite or weight gain" (APA 1987, p. 150).

Physical dependence refers to the condition in which withdrawal symptoms have been observed. Physical dependence can complicate the process of achieving and

Table 4. Criteria for drug dependence

Primary criteria

- Highly controlled or compulsive use
- Psychoactive effects
- Drug-reinforced behavior

Additional criteria

Addictive behavior often involves the following:

- Stereotypic patterns of use
- Use despite harmful effects
- Relapse following abstinence
- Recurrent drug cravings

Dependence-producing drugs often manifest the following:

- Tolerance
- Physical dependence
- Pleasant (euphoric) effects

Source: Adapted from USDHHS (1988).

maintaining drug abstinence, and the symptoms can be so unpleasant as to precipitate relapse (Jaffe 1985; USDHHS 1988). In surveys by the National Institute on Drug Abuse (NIDA), withdrawal and inability to maintain abstinence are commonly attributed to cigarette smoking and heroin use (USDHHS 1988). The majority of people monitored who regularly use other addictive drugs (including cocaine and marijuana) report that they have not experienced withdrawal, even though many of these people feel dependent and have been unable to maintain abstinence (USDHHS 1988).

Severity of Nicotine Addiction

Tobacco-delivered nicotine can be highly addictive. Each year, nearly 20 million people try to quit smoking in the United States (USDHHS 1990), but only about 3 percent have long-term success (Pierce et al. 1989; Centers for Disease Control and Prevention [CDC], Office on Smoking and Health, unpublished data). Even among addicted persons who have lost a lung because of cancer or have undergone major cardiovascular surgery, only about 50 percent maintain abstinence for more than a few weeks (West and Evans 1986; USDHHS 1988). In a 1991 Gallup Poll, 70 percent of current smokers reported that they considered themselves to be "addicted" to cigarettes (Gallup Organization 1991). These findings are consistent with data from NIDA's 1985 National Household Survey on Drug Abuse (NHSDA), which showed that 84 percent of 12- through 17-year-olds who smoked one pack or more of cigarettes per day felt that they "needed" or were "dependent" on cigarettes (Henningfield, Clayton, Pollin 1990). The NHSDA data show that young smokers develop tolerance and dependence, increase the amount they smoke, and are unable to abstain from nicotine. These findings suggest that the addictive processes in adolescents are fundamentally the same as those studied in adults (USDHHS 1988; Henningfield, Clayton, Pollin 1990).

Several studies have found nicotine to be as addictive as heroin, cocaine, or alcohol (Henningfield, Clayton, Pollin 1990; Henningfield, Cohen, Slade 1991; Kozlowski et al. 1993). Moreover, because the typical pattern of tobacco use entails daily and repeated doses of nicotine, addiction is more common among all users than is true of other drug use, which tends to occur on a far less frequent basis (USDHHS 1988). For example, only about 10 to 15 percent of current alcohol drinkers are considered problem drinkers, but approximately 85 to 90 percent of cigarette smokers smoke at least five cigarettes every day (Henningfield, Cohen, Slade 1991; Evans et al. 1992; Henningfield 1992b; Kozlowski et al. 1993). Only 2 to 3 percent of smokers (or about 7 to 10 percent of those who try quitting) stop smoking for one year

(CDC 1993a), and most daily smokers report that they feel dependent on smoking and have experienced withdrawal symptoms (USDHHS 1988; Henningfield, Clayton, Pollin 1990).

Chemistry and Addiction Potential

Many behaviors that become regular, habitual, and hard to give up involve the ingestion of a substance. What sets drug addictions apart from less harmful habits is that the ingested substance releases a psychoactive drug with the demonstrated potential to addict. Several thousand chemicals are present in cigarette smoke. Some may conceivably modulate nicotine's addictive effects, but the fact that different forms of nicotine delivery can be substituted for one another (e.g., nicotine gum or transdermal patch in place of cigarettes) suggests that nicotine is critical in the addiction process (Henningfield 1984; Benowitz 1988; USDHHS 1988; Russell 1990).

Nicotine is a naturally occurring alkaloid present in varying concentrations in different strains of tobacco. Most cigarettes sold in the United States contain about 8 to 9 milligrams of nicotine, of which the smoker typically ingests 1 to 2 milligrams per cigarette (Benowitz et al. 1983; USDHHS 1988). Nicotine is both a lipid- and water-soluble molecule that can be rapidly absorbed in a mildly alkaline environment through the skin or the lining of the mouth and nose. Because of the massive area for absorption in the alveoli of the lungs, nicotine inhaled deeply is almost immediately extracted from the smoke into the pulmonary veins; this sudden spike or bolus of nicotine is delivered to the brain, via arterial circulation, in approximately 10 seconds (USDHHS 1988). In contrast, although smokeless tobacco has much higher levels of nicotine than cigarettes, the delivery of the drug is much more gradual; the effect peaks within approximately 20 minutes of use (Benowitz et al. 1988). The peak for nicotine replacement medications is even slower—30 minutes or longer for nicotine gum (Benowitz et al. 1988), several hours for the four commercially available transdermal patch systems (Palmer, Bucklet, Faulds 1992). In fact, because of the efficiency of the pulmonary route in extracting nicotine from inhaled tobacco smoke, nicotine may be 10 times more concentrated in arterial blood than in simultaneously sampled venous blood; these levels are much higher than those produced by nicotine replacement medications (Henningfield, London, Benowitz 1990).

As vehicles for nicotine delivery, tobacco products are convenient to use, and they provide the experienced user with a means of regulating dose level. Such control does not, however, protect the user against drug dependency, since tobacco products appear to deliver the optimal addiction potential (or abuse liability) of nicotine. Chemicals can be tested for their addiction potential to

determine if they are psychoactive and if they can serve as reinforcers in animals and humans (Brady and Lukas 1984; USDHHS 1988; Fischman and Mello 1989; Henningfield, Cohen, Heishman 1991). These methods to test for abuse liability are reliable enough for the Food and Drug Administration (FDA) and the World Health Organization (WHO) to use them to develop policies regarding regulation of new drugs with possible addiction potential (USDHHS 1988; Barcelona Conference 1991). Nicotine meets the criteria for addiction potential in all of the standardized tests used by the FDA and the WHO (USDHHS 1987, 1988, 1991a). In humans and animals, nicotine produces discrete subjective effects more similar to those produced by cocaine than to those produced by sedatives, and nicotine injections are biologically reinforcing to humans and to at least five animal species (Henningfield, Miyasato, Jasinski 1985; Henningfield and Goldberg 1988; USDHHS 1988). Such findings confirm the conclusion of the 1988 report of the Surgeon General: nicotine is a drug with a liability for addiction (USDHHS 1988).

Pathophysiology of Nicotine Dependence

The pathophysiology of drug dependence and the clinical course of nicotine and other drug dependencies have been described in detail elsewhere (Jaffe 1985; USDHHS 1988; Benowitz 1992; Henningfield 1992a). In brief, exposure to a psychoactive chemical leads to repetitive self-administration because of the chemical's capacity to condition behavior. This powerful conditioning action of nicotine is mediated at least in part by the activation of nicotinic receptors in the brain (USDHHS 1988; Bock and Marsh 1990) and the modulation of levels of hormones such as epinephrine (adrenaline) and cortisol (Pomerleau and Pomerleau 1984; Sachs 1987; USDHHS 1988). The mesolimbic dopaminergic reward system, which mediates the addicting actions of cocaine, is also thought to be involved in producing nicotine's addictive effects (Pomerleau and Pomerleau 1984; USDHHS 1988; Bock and Marsh 1990; Balfour 1991a, b; Benwell and Balfour 1992). Behaviors that are followed by intense neural activation can become highly persistent and difficult to modify (Pomerleau and Pomerleau 1984; Jaffe 1985; USDHHS 1988). Each year, the daily cigarette smoker may experience 50,000 to 100,000 such pairings of puffing on cigarettes and resultant effects in the brain, thus establishing a persistent need for cigarette smoking.

Tolerance

Tolerance refers to a diminishing response to a drug through repeated exposures (Jaffe 1985; USDHHS 1988). Tolerance is often demonstrated when increased dose levels are required to obtain the effects formerly

produced by lower doses. Tolerance to nicotine appears to be acquired as people progress from initially smoking a few cigarettes to smoking greater numbers of cigarettes more often (see "Initiation Continuum of Smoking" and "Adult Implications of Adolescent Smoking" in Chapter 3 and "Developmental Stages of Smoking" in Chapter 4). The development of tolerance to the aversive effects of nicotine, such as nausea and dizziness, may also facilitate the development of dependency (USDHHS 1987; Shiffman et al. 1990; Shiffman 1989, 1991; McNeill, Jarvis, West 1987). Tolerance of nicotine increases over time; experienced smokers can self-administer doses of nicotine that would make nonsmokers ill.

The tolerance the nervous system develops to nicotine exposure can be at least partially overcome by increasing the dose. This effect was studied near the beginning of the 20th century and has been the subject of considerable study since then (Langley 1905; USDHHS 1988; Benowitz and Jacob 1993). Tolerance to various behavioral, physiologic, and subjective effects of nicotine has been studied (USDHHS 1988). For example, administering nicotine to a tobacco-deprived cigarette smoker can produce a substantial increase in heart rate and measures of euphoria, along with a decrease in the strength of the knee reflex. With repeated doses, the heart rate stabilizes at a level between that produced by the first dose and that which occurs when nicotine-deprived; subjective effects are minimal, and the knee reflex may become normal (Domino and Von Baumgarten 1969; USDHHS 1988; Swedberg, Henningfield, Goldberg 1990).

Some tolerance of nicotine is lost each night as the smoker's nicotine levels fall; the nicotine from the first few cigarettes of the day produces effects on heart rate, mood, and other measures that are stronger than the effects produced by subsequent doses during the day (USDHHS 1988). Repeated exposure to nicotine leads to morphological changes in the brain that cause the development of new binding sites for nicotine receptors, which mediate the effects of nicotine (Bock and Marsh 1990; USDHHS 1988, 1991a).

Animal research has shown that nicotine exposure results in an increased expression (defined as up-regulation) of nicotine receptors in various regions of the brain (Ksir et al. 1985; Morrow, Loy, Creese 1985; Nordberg et al. 1985; Schwartz and Kellar 1985; Ksir, Hakan, Kellar 1987). Prenatal exposure to nicotine also produces up-regulation of nicotine receptors in tissue collected from newborn animals (Slotkin, Orband-Miller, Queen 1987; Slotkin et al. 1991; Smith, Seidler, Slotkin 1991). These data suggest the broad applicability of this up-regulation effect, which may be one of the ways in which tolerance of nicotine occurs (USDHHS 1989).

Human research is more limited than animal research in this area, but there is evidence that cigarette smoking is associated with up-regulation of nicotine receptors in the human brain. Balfour (1989, 1991a) has conducted a series of studies that included the examination of postmortem brain tissue from smokers and nonsmokers. He and others found evidence of significantly elevated concentrations of nicotine binding sites as well as smoking-related changes in other binding sites (such as 5-hydroxytryptamine) (Benwell, Balfour, Anderson 1988; Balfour 1989, 1991a; Grant, McMurdo, Balfour 1989; Bock and Marsh 1990). Morphologic changes in the nervous system are presumed to reflect part of the body's adaptation (resulting in tolerance and physical dependence) to a prolonged exposure to nicotine (Marks and Collins 1982; Marks, Burch, Collins 1983; Marks et al. 1985, 1986; Marks, Stitzel, Collins 1985, 1986, 1987; USDHHS 1988).

Physical Dependence

Nicotine administered to animals and humans produces altered spontaneous electroencephalograph (EEG) and evoked electrical potentials of the brain, altered local cerebral glucose metabolism, modulation of hormonal output by the adrenal glands, increased heart rate, and changes in skeletal muscle tension (USDHHS 1988). Most, if not all, of these effects are related to the dose of nicotine given, and tolerance develops to differing degrees across these effects. After a period of nicotine exposure that is assumed to be at least several weeks (APA 1987), physical dependence on nicotine develops. The dependent person then appears to be functioning normally when under the influence of nicotine; conversely, the person may report feeling "abnormal" or "not right" when deprived for more than a few hours (Casey 1987).

Although basic pharmacologic research on nicotine has been conducted primarily with adults, most people begin to smoke in adolescence and develop characteristic patterns of nicotine dependence before adulthood (USDHHS 1988, 1991a). That adolescents develop physical dependence, as evidenced by their experience of withdrawal symptoms, has been well documented by the NHSDA (USDHHS 1991c). Moreover, quantitative characteristics of the withdrawal syndrome appear to be the same in adolescents and adults (McNeill et al. 1986; McNeill, Jarvis, West 1987).

The magnitude of the withdrawal syndrome is related to the previous level of nicotine intake, although differences in just a few cigarettes a day may not be correlated with the severity of the syndrome (Killen et al. 1988; USDHHS 1988). Environmental context is also a factor; in a novel environment (e.g., a hospital setting), the symptoms of nicotine withdrawal may be less than in the smoker's usual environment, with its various

psychological cues for smoking (Hatsukami, Hughes, Pickens 1985). The time course of withdrawal symptoms varies among individuals and for different responses. Most withdrawal symptoms peak within the first few days of nicotine abstinence and then begin to recover along a variable course; the most severe total withdrawal syndrome usually lasts about three to four weeks (USDHHS 1988; Gross and Stitzer 1989). For example, certain measures of brain function (such as P300-evoked electrical potential) recover within a few days, but others may take weeks or more (such as N100-evoked potential, hunger, and craving). Powerful urges to smoke may recur for many years (Hughes and Hatsukami 1986; USDHHS 1988).

Although questions remain, the pathophysiology of nicotine dependence clearly involves the brain, the endocrine system, and behavior, and the process begins when cigarette smoking is initiated. Moreover, although the effects of nicotine administration and deprivation are complex, they are orderly and are related to factors such as the amount of nicotine administered and the time since the last dose.

The Clinical Course of Nicotine Dependence

Like other drug addictions, nicotine dependence is a progressive, chronic, relapsing disorder. The level of dependence on nicotine in adults has been found to be inversely related to the age at initiation of smoking when measured by diagnostic criteria (APA 1987) of the APA (Breslau, Fenn, Peterson 1993) and by the Fagerström Tolerance Questionnaire Score (Henningfield et al. 1987).

As is true for most drug addictions, tobacco use is not always constant from initiation on; the process of graduation from first use to addiction can take months or even years (USDHHS 1988). In fact, initial experiences with tobacco, as with other addictive substances, are sometimes negative and require social pressures and other factors to maintain exposure until the addiction develops (Haertzen, Kocher, Miyasato 1983). The percentage of people who progress from smoking a few cigarettes to smoking at a regular, addictive level has been estimated to range from 33 to 94 percent. For example, Russell (1990) has reported that a survey of adults in Great Britain in the mid-1960s indicated that 94 percent of those who smoked more than three cigarettes became "long-term regular smokers." These data, which precede widespread public awareness of the hazards of smoking, may have a limited applicability to current smoking behavior. Recently collected data in the United States and Great Britain suggest that between 33 and 50 percent of people who try smoking cigarettes escalate to regular patterns of use (Hirschman, Leventhal, Glynn 1984; McNeill 1991; Henningfield, Cohen, Slade 1991).

The chronic phase of the addictive process is highly resistant to substantial modification. For example, efforts to reduce tobacco smoke and nicotine exposure by smoking cigarettes with lower ratings of nicotine delivery or to smoke fewer cigarettes are usually partially or completely thwarted by compensatory changes in how the cigarettes are smoked; smokers may compensate for "cutting back" by inhaling more deeply or smoking the cigarette farther down to its more potent and more toxic end (Kozlowski 1981, 1982; Benowitz et al. 1983; Benowitz and Jacob 1984; USDHHS 1988). Abstinence from smoking is generally short-lived; the majority of persons who quit on their own or in minimally supportive interventions appear to relapse within one week of their last cigarette (Kottke et al. 1989). In fact, in testament to the persistence of addiction, nearly one-third of those who have abstained for one year after quitting relapse later (USDHHS 1990; Giovino 1991). These patterns of relapse are similar to those observed with other drug addictions.

Several potential predictive measures of the severity of addiction in a person may forecast the severity of withdrawal and the outcome of an attempt to quit. These measures, which have been discussed in detail in the 1988 report of the Surgeon General (USDHHS 1988), include cotinine level in biological fluid such as saliva, blood, or urine; number of cigarettes smoked per day; score on the Fagerström Tolerance Questionnaire; and number of symptoms attributed from the *Diagnostic and Statistical Manual of Mental Disorders* (APA 1987). These measures tend to predict, although not perfectly, the difficulty of achieving abstinence, the severity of withdrawal symptoms, the rapidity of relapse, and the efficacy of replacement therapy (USDHHS 1988).

One final source of vulnerability to nicotine dependence appears to be genetic predisposition. Research with animals has shown that the amount of up-regulation (increased binding in the brain) of nicotine receptors after

nicotine exposure is related to genetic constitution, as are certain behavioral and physiologic effects (Marks et al. 1989; Collins 1990). Data from studies with human twins have yielded indices of heritability for cigarette smoking similar to those for drinking alcohol (Hughes 1986; Kozlowski 1991; Carmelli et al. 1992).

Nondrug Factors in Nicotine Dependence

Nondrug factors can affect the prevalence of drug addiction in society as well as its severity in individuals. Some of the factors are the same as those that determine the prevalence and severity of other medical disorders resulting from exposure to toxins. Among the most important factors in determining the prevalence of drug addiction is the exposure to the addicting substance (USDHHS 1988). This factor is no less important in the spread of drug addiction than it is in the spread of disorders such as acquired immunodeficiency syndrome, malaria, and influenza infections. Moreover, social factors can determine the type and frequency of exposure to the etiologic agent, as well as the time frame over which exposure continues. Many nondrug factors associated with both abstinence and relapse appear to operate similarly across addictions. These factors include illness induced by drug dependence (which will at least temporarily interrupt drug use), ability to learn to manage cravings, social reinforcements for abstinence, availability of the substance, cost of the substance, and perception of the risk of using the substance (USDHHS 1988).

Persons vary in their vulnerability to nicotine and other drug addiction, just as they vary in their vulnerability to other medical disorders; some people show a high degree of resistance to the disorder despite multiple exposures to the agent, and others very quickly become addicted (USDHHS 1988). Psychosocial factors affecting the vulnerability of the young and the onset of tobacco use are discussed in Chapter 4.

Smoking as a Risk Factor for Other Drug Use

Introduction

The 1988 Surgeon General's report (USDHHS 1988) showed that among adolescents, cigarette smoking is a risk factor in the development of alcohol use and illegal drug use. The nature of the interrelationship between tobacco and other drug use is complex; in several possible ways, tobacco use may heighten the probability that a young person will use other drugs (Slade 1993; see

"Smoking and Other Drug Use" in Chapter 3 and "Behavioral Factors in the Initiation of Smoking" in Chapter 4).

Progression of Drug Use

Kandel (1975) found that studies of the progression of drug use in the 1970s showed that cigarette smoking and alcohol use generally preceded marijuana smoking and other illegal drug use. In fact, Kandel's study

concluded that virtually everyone who used illegal drugs such as marijuana or cocaine had previously used cigarettes, alcohol, or both. These findings, primarily among white youths, have been repeatedly extended and replicated (e.g., Fleming et al. 1989; Kandel and Yamaguchi 1993).

More recent data from the Monitoring the Future Project (MTFP) by NIDA (USDHHS 1988) confirm that illegal drug use is rare among those who have never smoked and that cigarette smoking is likely to precede the use of alcohol or illegal drugs. The 1985–1989 MTFP showed that first use of tobacco had occurred at the same age as first use of alcohol for 33 percent of the sample; cigarettes were used before alcohol by 49 percent of the sample. The same survey showed that among those who had used both cigarettes and marijuana, 23 percent began using both in the same year, and 65 percent smoked cigarettes before marijuana. The latter relationship was more pronounced for cocaine: 98 percent of persons who had used both cocaine and cigarettes smoked cigarettes first (see Tables 24–26 in Chapter 3).

These findings were extended in another longitudinal study that assessed 12-, 15-, and 18-year-olds in New Jersey and reinterviewed them at three-year intervals (USDHHS 1987). This study showed that among 15-year-olds, the use of cigarettes, alcohol, or marijuana was the strongest predictor of cocaine use when these same persons were reinterviewed three years later; at that time, the persons using cocaine were likely to be using cigarettes and alcohol as well.

Cigarette smoking in combination with alcohol use appears to be especially predictive of illegal drug use. A longitudinal study by Yamaguchi and Kandel (1984) examined initial data from students in the tenth and eleventh grades in New York State in 1971. When the authors reevaluated the same students in 1981 (average age, 25 years), the most common sequence of drugs used was alcohol, cigarettes, marijuana, illegally used psychoactive or prescription drugs, and other illegal drugs. The investigators found that for 87 percent of the men, alcohol use preceded marijuana use; alcohol and marijuana use preceded other illegal drug use; and use of alcohol, cigarettes, and marijuana preceded the use of other psychoactive drugs. For 86 percent of the women, a similar, but not identical, pattern emerged: alcohol or cigarettes preceded marijuana; alcohol, cigarettes, and marijuana preceded other illegal drugs; and alcohol and either cigarettes or marijuana preceded other psychoactive drugs. These findings were replicated with 1,108 high school seniors in New York in 1988 (Kandel and Yamaguchi 1993). This study confirmed the importance of cigarette and/or alcohol use in the progression of illegal drug use, with early cigarette

use being of particular importance in the development of other drug use among females. Early onset of cigarette smoking and/or alcohol use was a strong predictor of further drug use.

The relationship between alcohol use and cigarette smoking is more complex than would be suggested by examining any one survey. In some studies, alcohol is more likely to precede than to follow cigarette smoking. This variability might be explained by the differing study criteria for alcohol use. For example, among many adolescents, alcohol consumption is characterized by the occasional light use of beer or wine—a pattern that often neither escalates into patterns of heavy drinking nor predicts other drug use (Kandel, Margulies, Davies 1978; Huba, Wingard, Bentler 1981; O'Donnell and Clayton 1982). This finding is consistent with the observation that approximately 85 percent of people who drink alcoholic beverages do so in patterns that do not meet criteria for abuse (USDHHS 1988). On the other hand, consumption of "hard liquor," sometimes accompanied by heavy drinking patterns, appears to develop either along with or following the development of regular patterns of cigarette smoking (Kozlowski et al. 1993; DiFranza and Guerrero 1990). These observations are consistent with the findings of the 1985 NHSDA, which showed that among 12-through 17-year-old adolescents who had never smoked, only 3 percent had binged (i.e., had five or more drinks in a row) in the past 30 days, whereas nearly 40 percent of daily smokers in this age group had binged in the past 30 days (USDHHS 1988).

The progression from cigarette smoking and occasional consumption of alcoholic beverages to heavier drinking and illegal drug use does not appear limited to any single population group. However, there is some evidence that boys with conduct disorders in school and at home may be at especially high risk of progression from any use of tobacco and alcohol to addictive patterns of multiple-drug use. A recent study of 61 males aged 14 through 18 who had conduct disorders found sequences of acquisition of drug use similar to those found among adolescents in general, but with higher rates of addictive use of the tobacco-alcohol-marijuana cluster and earlier initiation of these substances (Mikulich, Young, Crowley 1993).

Cigarette Smoking and Other Drug Use

Cigarette smoking is neither necessary nor sufficient for other drug abuse or dependence. Not all cigarette smokers subsequently abuse other drugs, and a small percentage of abusers of alcohol and illegal drugs do not use tobacco. However, several studies have revealed that cigarette smoking is a predictor of whether an individual is using other drugs and of what that individual's level of other drug use is. The 1985 NHSDA

(USDHHS 1988; Henningfield, Clayton, Pollin 1990) showed that 12- through 17-year-olds who had smoked cigarettes in the past 30 days were approximately 3 times more likely to have consumed alcohol, 8 times more likely to have smoked marijuana, and 22 times more likely to have used cocaine in the past 30 days than those who had not smoked cigarettes. Data from the 1985–1989 MTFP showed that seniors who had smoked cigarettes in the past 30 days were about 1.6 times more likely to have consumed alcohol, 4 times more likely to have smoked marijuana, and 5 times more likely to have used cocaine in the past 30 days than those who had not smoked cigarettes (see “Smoking and Other Drug Use” and Table 23 in Chapter 3).

The 1985 NHSDA (USDHHS 1988; Henningfield, Clayton, Pollin 1990) examined heavier drug use as a function of cigarette smoking. Having 5 or more drinks in succession in the past 30 days, using marijuana on more than 10 occasions, and using cocaine on more than 10 occasions were considered heavier usage of drugs. A strong association was observed between cigarette smoking and other drug use among all age groups in this study, although the percentage of the increases in drug use from the never-smoker to the daily-smoker levels was strongest in the 12- through 17-year-old group (Figure 1). Among these youngest smokers, those who smoked daily were approximately 14 times more likely to have binge on alcohol, 114 times more likely to have used marijuana at least 11 times, and 32 times more likely to have used cocaine at least 11 times than those who had not smoked.

A similar correlation between frequency of alcohol use and level of cigarette smoking was found in a study of 7th- through 12th-grade students in New York State (Welte and Barnes 1987). In the Welte and Barnes study, as in the NHSDA, not only were smoking any cigarettes and drinking alcohol related, but daily smoking was a predictor of binge drinking. These data are consistent with those from a study of adult multiple-drug abusers, which found that severity of nicotine dependence, as measured either by a scale that assesses the strength of a given habit or by cigarettes smoked per day, was correlated directly with severity of alcohol consumption problems, as measured by scores on the Michigan Alcoholism Screening Test (Kozlowski et al. 1993). These data indicate a strong direct relationship between level of nicotine dependence and alcohol abuse but do not in themselves show the direction of the relationship or rule out the possibility that other factors commonly determine the coincidental occurrence of high levels of tobacco and other drug use.

Data from a longitudinal study in which 4,192 students (grades six through eight) were surveyed three times over four years extended the findings that the

amount of tobacco use is directly related to other drug use (Bailey 1992). Specifically, this study showed that students who during follow-up periods escalated from low-level use of tobacco or alcohol to heavy-level use were more likely to begin using other psychoactive substances or to increase their use of these substances than students who remained low-level users of tobacco or alcohol (Bailey 1992).

Other studies suggest that the age at onset of cigarette smoking determines the probability of subsequent use of marijuana and of heavy alcohol use. For example, Clayton and Ritter (1985) found not only that cigarette smoking, along with alcohol use, was the most powerful predictor of marijuana use, but also that the effect was strongest when smoking was initiated by age 17. Similarly, Keenan (1988) found that the age at onset of cigarette smoking was significantly younger in people with a history of alcoholism than in those who did not use alcohol.

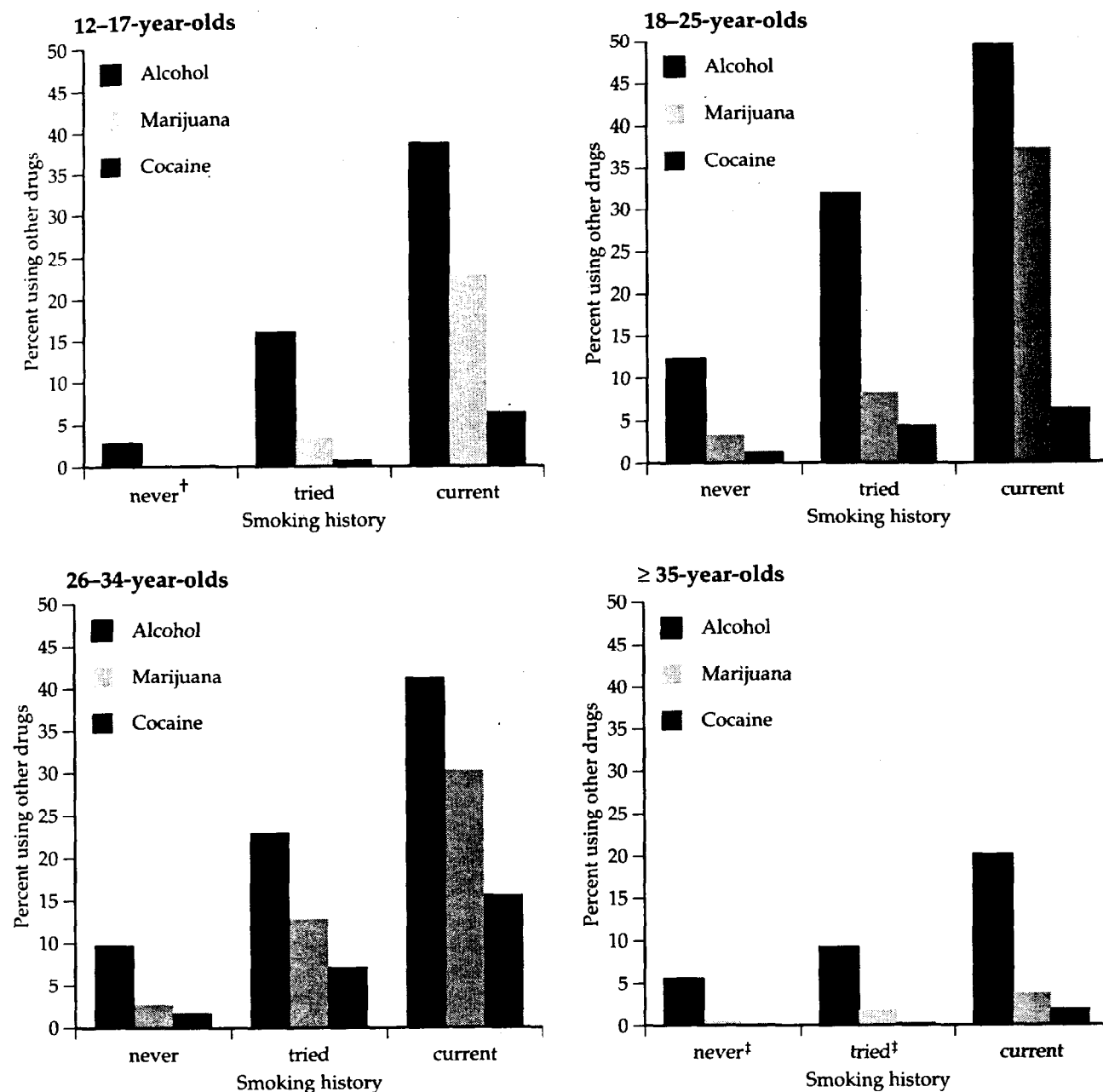
Another study estimated that the relative risk of alcoholism was increased tenfold among cigarette smokers and that people who heavily use alcohol represent approximately one-third of all cigarette smokers (DiFranza and Guerrera 1990). A further analysis of these and additional data led Kozlowski et al. (1993) to conclude that because the association between smoking and drinking is weaker among light smokers, the percentage of heavier smokers who develop problems with alcohol might be greater than 30 percent.

Of all drug users surveyed by the NIDA, cigarette smokers were by far the most likely to report experiencing various features of addiction. Among 12- through 17-year-olds who had used cigarettes, 27 percent were daily users and 20 percent felt dependent; of those who had used alcohol, 6 percent were daily users and 5 percent felt dependent; of those who had used marijuana, 18 percent were daily users and 10 percent felt dependent; of those who had used cocaine, 14 percent were daily users and 6 percent felt dependent (USDHHS 1988; Henningfield, Clayton, Pollin 1990). Cigarette smoking was also, by far, the drug use most commonly associated with withdrawal symptoms. Thus, cigarette smoking not only occurs early in the progression of drug use, it appears to be the first of these drugs to produce features of addiction in young people.

Smoking as a Facilitator for Other Drug Use

A number of mechanisms could explain how cigarette smoking facilitates the use of alcohol and illegal drugs. These mechanisms are not mutually exclusive. Moreover, other variables may operate to nondifferentially increase the use of tobacco and a wide range of other substances. For example, children with conduct disorders are at increased risk of using tobacco, heroin, alcohol,

Figure 1. Use of alcohol, marijuana, and cocaine,* by age group, National Household Survey on Drug Abuse, 1985



Source: USDHHS (1988).

*The criteria for current use are as follows: alcohol = drank five or more drinks in a row at least 1 day in the past 30 days; marijuana = used marijuana more than 10 times; cocaine = used cocaine more than 10 times (N = 8,814).

[†]Values were under 1 for marijuana and cocaine use.

[‡]Values were under 1 for cocaine use.

cocaine, and other drugs (USDHHS 1988). Similarly, a longitudinal study showed that first-grade children who were characterized by their teachers as either shy or aggressive were significantly more likely than their peers to smoke cigarettes, drink alcohol, and use illegal drugs in their teenage years (Kellam, Ensminger, Simon 1980). Evidence of other predictive factors, however, does not rule out the possibility that young people who smoke have an increased risk of using other drugs.

Morphologic changes in brain structure that have been induced by nicotine exposure might predispose persons to the abuse of other drugs; this mechanism, however, has not yet been experimentally investigated. One possibility is that common pathways of drug-produced reinforcement in the brain might be altered so that the reinforcement produced by subsequent drug exposure is intensified. Central nicotinic receptors are known to be critical mediators of the reinforcing effects of nicotine (USDHHS 1988). In turn, activation of these receptors leads to activation of the dopaminergic reward system, which is critical in mediating the reinforcing effects of a wide variety of abused drugs, including cocaine and heroin. Thus, it is a plausible, but unproven, hypothesis that nicotine exposure would lead to a heightened sensitivity to the reinforcing effects of other drugs of abuse. This hypothesis is supported by the finding that the development of tolerance to nicotine is accompanied by the development of tolerance ("cross-tolerance") to alcohol (Burch et al. 1988; Collins et al. 1988). Other research with animals also shows that nicotine exposure, either alone or in combination with other drugs, may alter the behavioral responses to drugs of abuse, including alcohol and cocaine (Signs and Schechter 1986; Horger, Giles, Schenk 1992). These data together suggest a plausible biological basis for a causal role for tobacco use in the development of other substance abuse patterns, even if this role is shared by other risk factors.

Nicotine produces various effects that have been shown to be produced similarly by one or more other abused drugs; all of these findings were discussed in greater detail in the 1988 Surgeon General's report (USDHHS 1988) and elsewhere (Pomerleau and Pomerleau 1984). Nicotine administration produces feelings of pleasure and euphoria that elevate the same scales on the Addiction Research Center Inventory as the effects of heroin, cocaine, alcohol, and other abused drugs (Henningfield, Miyasato, Jasinski 1985; USDHHS 1988).

Human subjects report, and laboratory rats demonstrate, that nicotine produces acute effects that are more like a stimulant than a sedative (Henningfield, Miyasato, Jasinski 1985; USDHHS 1988). Nicotine administration causes cortical EEG activation (increase in alpha and beta frequency, decrease in beta power) that is associated with increased vigilance and improved cognitive function (USDHHS 1988; Pickworth, Herning, Henningfield 1989). Conversely, nicotine deprivation leads to EEG deactivation and concomitant decreases in vigilance and cognitive function (USDHHS 1988; Pickworth, Herning, Henningfield 1989). Nicotine administration modulates the various levels of catecholamines, which are important in the regulation of mood and reactions to stressful stimuli (Pomerleau and Pomerleau 1984; USDHHS 1988).

Partly through its effects on serotonergic systems in the brain, nicotine has some of the same effects on appetite as medications prescribed for this purpose. Nicotine can reduce skeletal muscle tension and thereby contribute to the feelings of pleasurable relaxation often attributed to various abused drugs. For all of these drugs, including nicotine, the specific effect produced is related to the dose of the drug administered. Thus, depending on the dose of the drug or drugs taken, the time since the last dose, and other factors, theoretically the user may achieve certain effects with any of several drugs, achieve various maximal effects through drug combinations, or use certain drug combinations in an effort to reduce certain adverse effects (Gardner 1980).

Certain trends in drug abuse that have become prominent over the past decade increase the potential role of cigarette smoking in the development of other forms of drug use. Specifically, there are increasing reports of smokable preparations of various drugs, including cocaine ("crack"), methamphetamine ("ice"), phencyclidine ("PCP"), and heroin, and marijuana continues to be smoked by large numbers of people (USDHHS 1988). Drug administration via smoking requires the user to learn to regulate dose and to become tolerant of the rapid onset and aversive effects of smoke inhalation. These basic skills may be learned through the process of becoming dependent on tobacco, as is discussed in "Developmental Stages of Smoking" in Chapter 4 of this report and in the 1988 report. Once learned, these skills can be transferred to other smoked drugs and can facilitate the process of experimentation with such drugs, as well as increase the potential for addiction.

Health Consequences of Smokeless Tobacco Use Among Young People

Introduction

Smokeless tobacco includes two main types: chewing tobacco and snuff. These products are made from the same type of dark- or burley-leaved tobacco. Most smokeless tobacco is grown in Kentucky, Pennsylvania, Tennessee, Virginia, West Virginia, and Wisconsin. Leaves are generally aged one to three years, but snuff tobacco leaves are aged longer than chewing tobacco leaves (Shapiro 1981). People who use chewing tobacco place a wad of loose-leaf tobacco or a plug of compressed tobacco in their cheek; snuff users place a small amount of powdered or finely cut tobacco (loose or wrapped in a paper pouch) between their gum and cheek (USDHHS 1992b). Smokeless tobacco users then suck on the tobacco and spit out the tobacco juices with accompanying saliva. As a consequence of the way in which smokeless products are used, smokeless tobacco is sometimes referred to as spit or spitting tobacco (USDHHS 1992b).

The most notable health consequences associated with smokeless tobacco use include halitosis (bad breath), discoloration of teeth and fillings, abrasion of teeth, dental caries, gum recession, leukoplakia, nicotine dependence, and various forms of oral cancer (USDHHS 1986b, 1992a; WHO 1988). Specifically, smokeless tobacco use has been implicated in cancers of the gum, mouth, pharynx, larynx, and esophagus (USDHHS 1986b; Winn 1988) and has also been indicated in early reports of the development of verrucous carcinoma (Winn 1988). Smokeless tobacco use may also play a role in cardiovascular disease and stroke, through increases in blood pressure, vasoconstriction, and irregular heartbeat (Hsu et al. 1980; Gritz et al. 1981; Schroeder and Chen 1985). Since nearly 25 percent of adult smokeless tobacco users also smoke cigarettes (CDC 1993b), the effects on the oral cavity may be synergistic, and the risks of developing cancer of the oral cavity and pharynx noticeably increase (Blum 1980).

Epidemiologic Evidence

The 1986 Surgeon General's report on smokeless tobacco use concluded that there is no safe use of tobacco. Despite that report and subsequent legislation, restrictions, and follow-up reports (USDHHS 1992a, b; see "Warning Labels on Tobacco Products" in Chapter 6 and "Smokeless Tobacco Advertising and Promotional Expenditures" in Chapter 5), smokeless tobacco use in the United States remains a serious concern. The use of smokeless tobacco by adults has remained relatively constant at about 5 percent for males and 1 percent for females. However, smokeless tobacco use among high

school males has become markedly more prevalent in the past two decades; about 20 percent report using smokeless tobacco in the past month (see "Current Use of Smokeless Tobacco" in Chapter 3 for documentation and further discussion of the prevalence of smokeless tobacco use). In some states, nearly one out of three high school males uses smokeless tobacco. There is little indication that use among young people is significantly declining (Glover et al. 1988; Boyd and Glover 1989; USDHHS 1992b; see "Current Use of Smokeless Tobacco" in Chapter 3).

Smokeless tobacco use primarily begins in early adolescence; some research indicates an average age of onset of 10 years (USDHHS 1992b). Among high school seniors who had regularly used smokeless tobacco, 23 percent reported that they had first tried the product by the sixth grade, and 53 percent by the eighth grade (see "Grade When Smokeless Tobacco Use Begins" in Chapter 3).

Health Consequences

A recent report of the Office of Inspector General (USDHHS 1992b) concluded that smokeless tobacco use causes serious, but generally not fatal, short-term health consequences among young people. The primary health consequences during adolescence include leukoplakia, gum recession, nicotine addiction, and increased risk of becoming a cigarette smoker. Leukoplakia and/or gum recession occur in 40 to 60 percent of smokeless tobacco users (USDHHS 1992b).

Leukoplakia has been defined by the World Health Organization as a lesion of the soft tissue that consists of a white patch (mucosal macule) or plaque that cannot be scraped off (Kramer et al. 1978; Axéll et al. 1984). Greer and Poulson (1983) examined 117 high school students who were smokeless tobacco users; oral soft-tissue lesions were found in 49 percent of these students. Oral leukoplakias carry a five-year malignant transformation potential of about 5 percent (Pindborg 1980, 1985; Bouquot 1987, 1991). If smokeless tobacco use ceases, the leukoplakia appears to regress or resolve entirely (Christen, McDonald, Christen 1991).

Gingival tissue recession (or gum recession) commonly occurs in the area of the oral cavity immediately adjacent to where smokeless tobacco is held. When smokeless tobacco remains exclusively in a specific intraoral location, gingival recession occurs among 30 percent (Weintraub et al. 1990) to over 90 percent (Schroeder et al. 1988) of users. Modéer, Lavstedt, and Åhlund (1980) found that snuff use among 13- and

14-year-old students could directly affect the gingival tissues, causing gingivitis, or gum inflammation. In a study of 565 adolescent male students with gingivitis in Georgia, Offenbacher and Weathers (1985) found that gingival recession was significantly more prevalent, and the odds of developing this condition were nine times greater, among smokeless tobacco users than among nonusers. Navy recruits from 45 states were examined to determine if smokeless tobacco use was associated with gingival recession (Weintraub et al. 1990). Results of the study showed that 31 percent of heavy users and 19 percent of nonusers or low users had gingival recession. Users' age and the intensity of smokeless tobacco use were significant factors in explaining variations in the degree of gingival recession. Two additional studies of adolescents failed to show an association between the use of smokeless tobacco and gingival recession (Wolfe and Carlos 1987; Creath et al. 1988), possibly because most of the users had been using the product for a short time.

Nicotine Addiction

The addictive qualities of smokeless tobacco are also a matter of major concern (Christen and Glover 1981; Glover, Christen, Henderson 1981; Glover et al. 1989; Hatsukami, Nelson, Jensen 1991). Smokeless tobacco users develop a nicotine dependency similar to that of cigarette smokers (Benowitz et al. 1988). This is not surprising, since smokeless tobacco users absorb at least as much nicotine as smokers do (Russell, Jarvis, Feyerabend 1980)—perhaps as much as twice the amount (Benowitz et al. 1988). The high pH of saliva favors absorption of nicotine through oral mucosa, and the degree of absorption increases with the increasing pH of the tobacco product. The rate of absorption of nicotine from snuff is particularly rapid (Russell, Jarvis, Feyerabend 1980; Edwards, Glover, Schroeder 1987). With continued use of smokeless tobacco, blood nicotine levels remain relatively high; these levels fall more slowly after smokeless tobacco is removed from the mouth than after a cigarette has been smoked (Benowitz et al. 1988).

Adolescents develop physical dependence from smokeless tobacco use, as is evidenced by their experience of withdrawal symptoms when they try to quit (see "Smokeless Tobacco Cessation" in Chapter 6). Smokeless tobacco cessation produces withdrawal symptoms that are similar to those for smoking cessation (Hatsukami, Gust, Keenan 1987), including cravings, irritability, distractibility, and hunger. Adolescents who are most addicted to nicotine appear to be less able to quit (Eakin, Severson, Glasgow 1989). Thus, as is seen with cigarette use (see "Adult Implications of Adolescent Smoking" in Chapter 3 and "Adolescent Smoking Behavior as a Risk Factor for Subsequent Smoking" in

Chapter 4), adolescents who are heavy smokeless tobacco users are likely to become adult users.

The addictive potential of smokeless tobacco use is aggravated by the fact that some smokeless products are highly effective in the initiation process and are even termed "starter products" by one smokeless tobacco company (Marsee v. United States Tobacco Company 1989; Henningfield and Nemeth-Coslett 1988). These products tend to be low in nicotine concentration and low in pH (thus reducing absorption); some are in a unit dosage form ("tobacco pouch"), which helps first-time users avoid placing too much of the substance in their mouths. These products may have contributed to the reversal of the demographics of smokeless tobacco users from 1970 to 1986. In 1970, the majority of smokeless tobacco users were 50 years old and older; by 1986, the majority were 35 years old and younger (USDHHS 1987, 1988). As is discussed in Chapter 5 (see "Smokeless Tobacco Advertising and Promotional Expenditures"), marketing and advertising factors have been identified as having instilled the general perception that smokeless tobacco products are safe and socially acceptable (Connolly et al. 1986; USDHHS 1987; Glover et al. 1989). Marketing strategies included a heavy reliance on distributing free samples of product types designed to introduce new users to what one company termed the "graduation process" (Marsee v. United States Tobacco Company 1989). Advertising strategies then encouraged new users to experience greater "satisfaction" and "pleasure" by switching to maintenance products higher in nicotine concentration and pH (Marsee v. United States Tobacco Company 1989; Henningfield and Nemeth-Coslett 1988).

Smokeless Tobacco Use as a Risk Factor for Cigarette Smoking

Young people who use smokeless tobacco appear to be at greater risk to smoke cigarettes than are nonusers. Among smokeless tobacco users, 12 to 43 percent also smoke cigarettes (Eakin, Severson, Glasgow 1989; Williams 1992; CDC 1993b; Stevens et al., in press; see Table 23 in Chapter 3). In the 1986–1989 MTFP, 44 percent of high school seniors had tried both smokeless tobacco and cigarettes; of those, 63 percent had tried smokeless tobacco either before or at about the same time as cigarettes (see Table 38 in Chapter 3). In a prospective study, Ary, Lichtenstein, and Severson (1987) found that smokeless tobacco users were significantly more likely than nonusers to initiate cigarette smoking. Smokeless tobacco users were also more likely to increase their use of cigarettes over a one-year period. For adolescents who use both smokeless tobacco and cigarettes, cessation of one substance may lead to a direct increase in the other (Biglan, La Chance, Benowitz, unpublished data).

Smokeless Tobacco Use as a Risk Factor for Other Drug Use

Smokeless tobacco use is also predictive of other drug use. In a study of more than 3,000 male adolescents interviewed twice at nine-month intervals about their use of various psychoactive substances (Ary, Lichtenstein, Severson 1987), the main findings were that (1) smokeless tobacco users were significantly more likely to use cigarettes, marijuana, or alcohol than nonusers, (2) users of smokeless tobacco were significantly more likely to take up the use of these other substances by the second interview if they were not using them at the first, and (3) adolescents who were using any of these substances at the

first interview were significantly more likely to increase their use of the substance if they also used smokeless tobacco.

Two other facts are important to consider when evaluating the role of smokeless tobacco products in the use of cigarettes and other substances. First, the overall impact of smokeless tobacco is currently limited primarily to males (the main users of these substances) (USDHHS 1986b, 1990). Second, smokeless tobacco users in the Ary, Lichtenstein, and Severson (1987) study, as well as in most other surveys, tend to initiate their tobacco use at about the same age as cigarette smokers or at a slightly earlier age (see "Grade When Use of Smokeless Tobacco and Cigarettes Begins" in Chapter 3).

Conclusions

1. Cigarette smoking during childhood and adolescence produces significant health problems among young people, including cough and phlegm production, an increased number and severity of respiratory illnesses, decreased physical fitness, an unfavorable lipid profile, and potential retardation in the rate of lung growth and the level of maximum lung function.
2. Among addictive behaviors, cigarette smoking is the one most likely to become established during adolescence. People who begin to smoke at an early age are more likely to develop severe levels of nicotine addiction than those who start at a later age.
3. Tobacco use is associated with alcohol and illicit drug use and is generally the first drug used by young people who enter a sequence of drug use that can include tobacco, alcohol, marijuana, and harder drugs.
4. Smokeless tobacco use by adolescents is associated with early indicators of periodontal degeneration and with lesions in the oral soft tissue. Adolescent smokeless tobacco users are more likely than nonusers to become cigarette smokers.

Chapter 3: Epidemiology of Tobacco Use Among Young People in the United States

Introduction

Understanding national trends and patterns of tobacco use among adolescents is crucial to the public health effort to reduce tobacco-related morbidity and mortality. Along with information on young people's knowledge, attitudes, and perceptions concerning tobacco use, these data can help elucidate historical patterns, suggest target groups for programs to prevent tobacco use, determine the need for future interventions, assess the effect of national campaigns against tobacco use, and contribute to predictions of the future burden of tobacco-related disease.

Previous reports from the Surgeon General have described tobacco use among the nation's youth (U.S. Department of Health, Education, and Welfare [USDHEW] 1979a; U.S. Department of Health and Human Services [USDHHS] 1989b). The following analysis both updates and expands these discussions. In particular, the analysis incorporates cross-sectional data from four national surveillance systems that track health behaviors (including tobacco use) among adolescents and from one adult survey with information on older adolescents (Table 1). Data are also used from a national longitudinal survey of adolescents and young adults.

The National Teenage Tobacco Surveys (NTTS) cited in this chapter were conducted by the U.S. Public Health Service and the U.S. Department of Education in 1968, 1970, 1972, 1974, and 1979; a modified version of the survey was conducted in 1989 as the Teenage Attitudes and Practices Survey (TAPS). The National Household Surveys on Drug Abuse (NHSDA) cited were conducted nine times from 1974 through 1991 by the National Institute on Drug Abuse (NIDA); the survey is now sponsored by the Substance Abuse and Mental Health Services Administration (SAMHSA). The Monitoring the Future Project (MTFP) surveys included were conducted yearly from 1976 through 1992 for NIDA by the University of Michigan's Institute for Social Research (ISR). The Youth Risk Behavior Survey (YRBS), cited extensively throughout this chapter, was conducted in 1991 by the Centers for Disease Control (CDC) as a component of the Youth Risk Behavior Surveillance

System. The National Health Interview Surveys (NHIS) cited in this report included yearly data on cigarette smoking during 11 years from 1970 through 1991. Survey methodology varied across these surveillance systems (see Appendix 1, "Sources of Data," for more detail on methodologic characteristics), and the different surveys offered several measures of tobacco use (see Appendix 2, "Measures of Cigarette Smoking," and Appendix 3, "Measures of Smokeless Tobacco Use").

The most comparable of these data sources are TAPS, the NHSDA, the MTFP, and the YRBS. Because the questions used, the ages sampled, and the sites and modes of administration (school-based self-administered questionnaires vs. household-based telephone and in-person interviews) differ, however, even these data are not directly comparable. The MTFP, for example, consistently reports higher prevalence estimates than the two household surveys, mainly because the study population is limited to high school seniors; these respondents, who are usually 17 or 18 years old, are considerably older than the 12- through 18-year-old population included in TAPS and the NHSDA. When possible, most of the comparisons presented in this chapter include age- or grade-specific estimates. However, even after controlling for age differences, the estimates on some measures of tobacco use from the household surveys are lower than the estimates from the school surveys (see Appendix 2).

The purpose of this chapter is to document reported trends and patterns of tobacco use in one source. Differences in the age of the target populations employed, in the setting of the survey, in the wording of questions, and in other factors may cause apparent differences in the actual values of some of the estimates reported here. However, these differences are frequently resolved when methodological issues are taken into consideration. Incorporating data from several types of data collection systems has revealed a number of consistencies in patterns and trends of tobacco-use behaviors that apply to both school-based and household-based sample frames (and thus to school attenders, infrequent school attenders, and dropouts).

Table 1. Sources of national data on tobacco use among young people, 1968–1992

Survey title	Abbreviated title	Sponsoring agency or organization	Type of survey	Years
National Teenage Tobacco Surveys; 1989 Teenage Attitudes and Practices Survey	NTTS, TAPS	National Clearinghouse for Smoking and Health, National Cancer Institute, National Institutes of Health, National Institute of Education, Office on Smoking and Health (OSH), Centers for Disease Control and Prevention (CDC)*	Cross-sectional	1968, 1970, 1972, 1974, 1979, 1989
National Household Surveys on Drug Abuse	NHSDA	National Institute on Drug Abuse/ Substance Abuse and Mental Health Services Administration	Cross-sectional	1974, 1976, 1977, 1979, 1982, 1985, 1988, 1990, 1991
Monitoring the Future Project	MTFP	National Institute on Drug Abuse, University of Michigan, Institute for Social Research	Cross-sectional and longitudinal	1976–1992 annual surveys; 1976–1986 respondents contacted 5–6 years later
Youth Risk Behavior Survey	YRBS	Division of Adolescent and School Health, CDC	Cross-sectional (national, as well as state and local)	1991
National Health Interview Surveys	NHIS	National Center for Health Statistics (NCHS), CDC	Cross-sectional	1970, 1974, 1978–1980, 1983, 1985, 1987–88, 1990, 1991

Sources: NTTS: U.S. Department of Health, Education, and Welfare (1972, 1976, 1979b); TAPS: CDC (1991a); Allen et al. (1991, 1993); Moss et al. (1992); NHSDA: Abelson and Atkinson (1975); Abelson and Fishburne (1976); Fishburne, Abelson, Cisin (1980); Gfroerer (1993); Miller et al. (1983); U.S. Department of Health and Human Services [USDHHS] (1988a, 1990a, 1991a, 1992a, 1993); 1991 NHSDA: CDC, OSH (unpublished data); MTFP: Bachman, Johnston, O'Malley (1980a, b, 1981, 1984, 1985, 1987, 1991); Johnston, Bachman, O'Malley (1980a, b, 1982, 1984, 1986, 1991, 1992); Johnston, O'Malley, Bachman (1991a, b, 1992a, b, in press); 1990–1992 MTFP surveys: Institute for Social Research, University of Michigan (unpublished data); YRBS: Kolbe (1990); CDC (1992c, d); Kolbe, Kann, Collins 1993; CDC, Division of Adolescent and School Health (unpublished data); NHIS: NCHS (1958, 1975, 1985, 1988a, b, 1989); USDHHS (1992a); 1970, 1978–1980, 1987–1988 NHIS: CDC, OSH (unpublished data).

*The 1989 TAPS was partially sponsored by the American Cancer Society.

Mode of survey administration	Response rate	Ages/grades	Sample size	Type of tobacco use examined
Telephone interview, in-person interview, mailed questionnaire	82% in 1989	12-18 years	2,553-9,965	Smoking: all years Smokeless: 1989
Household interview	Mean of approximately 80%; 84% in 1991	17-19 years (trend data); 12-18 years (1991 analysis); 30-39 years (retrospective 1991 analysis)	371-3,429 9,086 6,388	Smoking: all years Smokeless: 1988-1991
Self-administered in school	77%-86% of sampled seniors; 66%-80% of selected schools; 70%-80% of seniors remained in panel 5 years later	12th grade: 1976-1992 10th grade: 1992 8th grade: 1992 23-24 years old when contacted 5-6 years later	15,091-18,448 [†] 14,726 [‡] 18,478 [§] 13,665 in panel	Smoking: all years Smokeless: 1986-1989, 1992
Self-administered in school	For national survey: 90% of sampled students; 75% of selected schools	9th-12th grades	12,272 in national survey	Smoking and smokeless
Household interview, limited telephone interview	Approximately 85%-90%	18-19 years (trend analyses for 1974-1991); ≥ 18 years (for reconstructed prevalence, using 1970, 1978-1980, and 1987 surveys); ≥ 18 years (for age of initiation of regular smoking analyses among females, 1970, 1978-1980, 1987-1988)	453-1,385 148,433 115,337	Smoking: all years

[†]The Institute for Social Research usually reports the N (weighted), which is approximately equal to the sample size. Cases are weighted to account for differential probability of selection and then normalized to average 1.0. The range for N (weighted) for questions on smokeless tobacco between 1986 and 1992 = 2,553-2,991.

[‡]N (weighted) for smokeless tobacco = 7,093.

[§]N (weighted) for smokeless tobacco = 8,441.

Cigarette Smoking Among Young People in the United States

Recent Patterns of Cigarette Smoking

Ever Smoking

The proportion of adolescents classified as ever smokers (i.e., those who had tried a cigarette [see Appendix 2 for variations in this measure]) varied across survey systems (Table 2). In the 1989 TAPS, 47 percent of students aged 12 through 18 had tried smoking. In the 1991 NHSDA, the prevalence for this same age range was 42 percent. The different estimates between these two household surveys may reflect actual decreased prevalence during the intervening two years or may result from sampling error, from slight differences in response to different survey questions, or from the different way these home-based surveys were administered (by telephone in TAPS and in person in the NHSDA). Of the two self-administered school surveys, the 1991 YRBS reported a higher prevalence of ever smoking (70 percent) than the 1992 MTFP (62 percent), even though the YRBS included students in grades 9 through 12 (age range generally 14 through 18 years), whereas the MTFP was limited to high school seniors. This difference may partly result from the questions each survey used to elicit information on ever smoking. The MTFP survey asked, "Have you ever smoked cigarettes?", and the YRBS asked a question that might have drawn additional affirmative responses: "Have you ever tried or experimented with cigarette smoking, even one or two puffs?"

What stands out from all four surveys is that by age 18, about two-thirds of adolescents in the United States have tried smoking. Also evident across the surveys is that the prevalence of ever smoking is greater (if only slightly so in one survey) among males than females. Findings by racial/ethnic groups were generally in accord across the surveys: whites had the highest prevalence of ever smoking and blacks the lowest in TAPS, the NHSDA, and the MTFP; Hispanics had the highest prevalence of the three groups in the YRBS.

Ever smoking increased as a function of increasing age or grade in all four surveys. Adolescents living in the north-central region of the United States were the most likely to report having smoked (Table 2). Prevalence for individual states were available from the Youth Risk Behavior Surveillance System, which besides its yearly national YRBS also conducts individual surveys in selected states and cities. In 1991, the percentage of students who had tried smoking ranged from 49 to 82 percent (median, 71 percent) (Table 3).

Current Smoking

The overall national prevalence of current smoking (i.e., having smoked within the last 30 days) for persons 12 through 18 years old was estimated to be 16 percent in the 1989 TAPS and 13 percent in the 1991 NHSDA (Table 4). These estimates suggest that at least 3.1 million U.S. adolescents are current smokers. Among high school seniors, the prevalence of past-month smoking was 28 percent in the 1992 MTFP; 28 percent of high school students were past-month smokers in the 1991 YRBS.

In all the surveys, current prevalence among males was equal to or slightly higher than current prevalence for females. This pattern differs from that reported for the late 1970s and mid-1980s, when the prevalence for adolescent females was generally higher than that for adolescent males (USDHEW 1979b; USDHHS 1989b).

The national prevalence of past-month smoking among adolescents was higher for whites than for Hispanics and was lowest for blacks (Table 4). Pooled data from the 1985–1989 MTFP provided information on smoking among Asian American and Native American adolescents (Bachman et al. 1991). Past-month smoking prevalence was higher for Native American male (37 percent) and female (44 percent) seniors than for white male (30 percent) and female (34 percent) seniors. Current smoking was about as common for Asian American male (17 percent) and female (14 percent) seniors as it was for black male (16 percent) and female (13 percent) seniors. Data on Hispanic smoking prevalence, presented in the same report, indicate that smoking prevalence among Hispanic high school seniors from 1985 through 1989 ranked between that of white and black high school seniors, as it did in TAPS, the NHSDA, and the YRBS.

Current prevalence increased with increasing age or grade (Table 4). TAPS and the NHSDA reported smoking prevalences for persons 17 and 18 years old that were slightly lower than those of 12th-grade students surveyed by the MTFP and the YRBS. Prevalence estimates from TAPS and the NHSDA for persons 15 and 16 years old were considerably lower than for 9th- and 10th-grade high school students in the MTFP and the YRBS. These estimates are consistent with the argument that estimates of cigarette smoking from household surveys may underreport actual use, especially for younger adolescents.

Table 2. Percentage of young people who have ever smoked cigarettes, by gender, race/Hispanic origin, age/grade, and region, Teenage Attitudes and Practices Survey (TAPS), National Household Surveys on Drug Abuse (NHSDA), Monitoring the Future Project (MTFP), Youth Risk Behavior Survey (YRBS), United States, 1989, 1991, 1992

Characteristic	1989 TAPS*	1991 NHSDA [†]	1992 MTFP ^{‡§}	1991 YRBS
Overall	46.5	41.9	61.8	70.1
Gender				
Male	48.3	44.4	63.5	70.6
Female	44.4	39.3	60.2	69.5
Race/Hispanic origin				
White, non-Hispanic	49.5	46.5	65.3	70.4
Male	51.5	49.1	66.2	71.4
Female	49.3	43.7	64.6	69.3
Black, non-Hispanic	36.4	28.1	42.6	67.2
Male	38.7	31.0	45.5	64.7
Female	34.1	25.0	40.4	69.3
Hispanic	43.1	34.4	NA [¶]	75.3
Male	42.5	36.1		75.7
Female	43.7	32.5		74.9
Age/grade				
12-14 years	29.7	26.0		
15-16 years	52.5	45.9		
17-18 years	63.9	60.9		
8th grade			45.2	
9th grade				64.8
10th grade			53.5	68.3
11th grade				72.8
12th grade			61.8	74.5
Region				
Northeast	46.0	39.7	63.7	70.6
North Central	47.9	46.2	65.2	73.0
South	46.5	41.1	61.1	71.3
West	45.0	40.3	56.5	65.0

Sources: **1989 TAPS:** Centers for Disease Control and Prevention (CDC), Office on Smoking and Health (OSH) (unpublished data); **1991 NHSDA:** CDC, OSH (unpublished data); **1992 MTFP:** Johnston, O'Malley, Bachman (in press); Institute for Social Research, University of Michigan (unpublished data); **1991 YRBS:** CDC (1992c); CDC, Division of Adolescent and School Health (unpublished data).

*1989 TAPS, aged 12-18 years. Based on responses to the questions, "Have you ever smoked a cigarette?" and "Have you ever tried or experimented with cigarette smoking, even a few puffs?" Respondents who had smoked a cigarette, even a few puffs, were classified as ever smokers.

[†]1991 NHSDA, aged 12-18 years. Based on response to the question, "About how old were you when you first tried a cigarette?" ("Never tried a cigarette" was a precoded response.)

[‡]1992 MTFP survey. Based on response to the question, "Have you ever smoked cigarettes?" Respondents who reported that they had tried cigarettes at least once or twice were classified as ever smokers.

[§]With the exception of data for 8th- and 10th-grade students, all other data points for the MTFP survey reflect estimates for high school seniors.

^{||}1991 YRBS, grades 9-12. Based on response to the question, "Have you ever tried cigarette smoking, even one or two puffs?"

[¶]NA = Not available.

Table 3. Percentage of high school students who use cigarettes, by gender, Youth Risk Behavior Surveys, United States and selected U.S. sites, 1991

Site	Lifetime cigarette use*			Current cigarette use†			Frequent cigarette use‡		
	Female	Male	Total	Female	Male	Total	Female	Male	Total
Weighted data									
National survey	70	71	70	27	28	28	12	13	13
State surveys									
Alabama	70	79	74	24	32	28	11	16	13
Georgia	66	72	69	22	26	24	10	12	11
Idaho	56	65	61	22	24	23	12	14	13
Nebraska	70	75	72	28	30	29	15	15	15
New Mexico	82	81	82	30	30	30	13	14	13
New York§	72	70	71	32	28	30	18	17	17
Puerto Rico ^Δ	46	54	50	13	18	16	3	5	4
South Carolina	72	76	74	25	26	26	13	13	13
South Dakota	68	71	69	32	30	31	17	16	16
Utah	43	55	49	16	18	17	8	8	8
Local surveys									
Chicago	72	73	72	13	20	16	4	7	6
Dallas	70	76	73	11	16	14	4	4	4
Fort Lauderdale	65	65	65	18	13	16	10	6	8
Jersey City	73	70	72	17	16	16	4	4	4
Miami	66	66	66	12	17	15	4	8	6
Philadelphia	82	70	76	22	17	20	11	8	10
San Diego	64	71	68	18	18	18	7	7	7
Unweighted data[¶]									
State surveys									
Colorado§	73	74	74	28	27	27	13	14	14
District of Columbia ^Δ	70	60	65	5	7	6	2	2	2
Hawaii	70	70	70	27	25	26	12	13	13
Montana	68	71	69	24	24	24	13	12	12
New Hampshire	71	71	71	28	27	27	16	15	15
New Jersey§	67	61	64	NA**	NA	NA	NA	NA	NA
Oregon	63	65	64	22	22	22	9	10	9
Pennsylvania§	69	73	71	28	28	28	16	15	15
Tennessee	72	75	74	30	30	30	16	16	16
Wisconsin	72	73	73	30	32	31	16	17	16
Wyoming	70	74	72	27	28	28	15	17	16
Local surveys									
Boston	68	68	68	15	16	15	6	9	7
New York City	76	68	72	26	16	21	12	6	9
San Francisco	61	63	62	14	15	14	7	6	6

Source: Centers for Disease Control (1992d).

*Ever tried cigarette smoking, even one or two puffs.

†Smoked cigarettes on 1 or more of the 30 days preceding the survey.

‡Smoked cigarettes on 20 or more of the 30 days preceding the survey.

§Surveys did not include students from the largest city.

ΔCategorized as a state for funding purposes.

¶Fourteen sites had overall response rates below 60% or had unavailable documentation; weighted estimates were not reported.

**NA = Not available.

Table 4. Percentage of young people who currently smoke cigarettes (within the past 30 days), by gender, race/Hispanic origin, age/grade, and region, Teenage Attitudes and Practices Survey (TAPS), National Household Surveys on Drug Abuse (NHSDA), Monitoring the Future Project (MTFP), Youth Risk Behavior Survey (YRBS), United States, 1989, 1991, 1992

Characteristic	1989 TAPS*	1991 NHSDA [†]	1992 MTFP ^{‡,§}	1991 YRBS ^Δ
Overall	15.7	13.1	27.8	27.5
Gender				
Male	16.0	13.5	29.2	27.6
Female	15.3	12.8	26.1	27.3
Race/Hispanic origin				
White, non-Hispanic	18.5	15.4	31.8	30.9
Male	18.7	15.5	32.1	30.2
Female	18.2	15.3	31.5	31.7
Black, non-Hispanic	6.1	5.3	8.2	12.6
Male	7.8	6.0	10.8	14.1
Female	4.9	4.6	5.8	11.3
Hispanic	11.8	10.1	NA [¶]	25.3
Male	11.8	9.5		27.8
Female	11.7	10.8		22.9
Age/grade				
12–14 years	5.9	3.9		
15–16 years	17.5	14.0		
17–18 years	27.5	25.5		
8th grade			15.5	
9th grade				23.2
10th grade			21.5	25.2
11th grade				31.6
12th grade			27.8	30.6
Region				
Northeast	17.6	14.7	29.6	23.7
North Central	16.6	14.9	31.7	36.5
South	14.0	11.7	26.4	24.8
West	15.5	12.3	22.8	23.1

Sources: 1989 TAPS: Centers for Disease Control and Prevention (CDC), Office on Smoking and Health (OSH) (unpublished data); 1991 NHSDA: CDC, OSH (unpublished data); 1992 MTFP: Johnston, O'Malley, Bachman (in press); Institute for Social Research, University of Michigan (unpublished data); 1991 YRBS: CDC (1992c); CDC, Division of Adolescent and School Health (unpublished data).

*1989 TAPS, aged 12–18 years. Based on responses to the questions, "Have you ever smoked a cigarette?" and "Think about the last 30 days. On how many of these days did you smoke?"

[†]1991 NHSDA, aged 12–18 years. Based on response to the question, "When was the most recent time you smoked a cigarette?"

[‡]1992 MTFP survey. Based on response to the question, "How frequently have you smoked cigarettes during the last 30 days?"

[§]With the exception of data for 8th- and 10th-grade students, all other data points for the MTFP survey reflect estimates for high school seniors.

^Δ1991 YRBS, grades 9–12. Based on response to the question, "During the past 30 days, on how many days did you smoke cigarettes?"

[¶]NA = Not available.

Past-month smoking was generally most common in the north-central region of the United States and least prevalent in the West and the South (Table 4). Among the available state and local surveys of high school students (Table 3), the percentage of students who were current smokers ranged from 6 to 31 percent (median 27 percent). From the weighted surveys, current smoking prevalence was lowest in Puerto Rico and Utah and highest in South Dakota, New Mexico, and New York (excluding New York City).

Frequent and Heavy Smoking

In the 1989 TAPS, 8 percent of U.S. adolescents 12 through 18 years old were frequent smokers (i.e., had smoked on 20 or more of the 30 days preceding the survey) (Table 5). In 1991, 13 percent of high school students surveyed in the YRBS were frequent smokers. In the 1991 NHSDA, 7 percent of persons 12 through 18 years old were heavy smokers (i.e., had smoked at least one-half pack per day); 10 percent of high school seniors in the 1992 MTFP survey were heavy smokers. Males were slightly more likely than females to report frequent or heavy smoking (Table 5).

To a greater extent than was found for current smoking, white adolescents were more likely than black or Hispanic adolescents to be frequent or heavy smokers. Among white adolescents in the different surveys, frequent and heavy smoking were 2.8 to 7.5 times more common than among black adolescents and 2.3 to 2.6 times more common than among Hispanic adolescents.

As was noted for both ever smoking and current smoking, frequent and heavy smoking increased with increasing age or grade. Frequent and heavy smoking were more prevalent in the north-central and northeast regions and less prevalent in the South and the West.

Sociodemographic Risk Factors for Smoking

In its surveys of high school seniors from 1985 through 1989, the MTFP elicited data on several possible sociodemographic risk factors for adolescent smoking (Table 6). The surveys found, for example, that students who lived alone had the highest prevalences of past-month smoking (47 percent) and heavy smoking (28 percent). Living in a single-parent household increased the risk of past-month or heavy smoking only when the mother was the absent parent. Data from the 1968, 1970, 1972, 1974, and 1979 NTTS indicate higher smoking prevalences among youth living in households with fewer than two parents or parent surrogates (USDHEW 1972, 1976, 1979b). The available published reports, however, did not provide more detail on the exact structure of the household.

The 1989 TAPS examined other aspects of family structure for possible associations with adolescent smoking status (Allen et al. 1993). The survey findings showed that youths 12 through 16 years old who were current smokers were almost twice as likely to be home without a parent or other adult for 10 or more hours a week than were teens who had never smoked. Furthermore, TAPS teens who said that they discussed serious problems with friends rather than with a parent, other relative, or another adult were two times more likely to be current smokers than were teens who reported discussing serious problems with their parents (Moss et al. 1992).

The 1985–1989 MTFP reported an inverse relationship between both past-month and heavy smoking and the population density of the locales in which the seniors grew up (Table 6); those seniors who grew up on a farm or in the country were more likely to smoke than those who grew up in large cities. The MTFP also found that as school performance among high school seniors declined from above average to below average, past-month smoking prevalence increased from 22 to 41 percent, and heavy smoking prevalence increased from 7 to 21 percent. A similar relationship was observed in the 1989 TAPS (Moss et al. 1992).

Postgraduation plans were another predictor of smoking behavior among MTFP seniors. Students who said they planned to complete four years of college were less likely to be past-month smokers (24 percent) or heavy smokers (7 percent) than were those who did not plan to get a college degree (39 percent were past-month smokers, 20 percent were heavy smokers). Males who planned to enter the armed forces after high school were more likely to be past-month smokers (31 percent) or heavy smokers (14 percent) than males who did not have such plans (26 percent were past-month smokers, 10 percent were heavy smokers). This association was negligible among females.

Among MTFP seniors, past-month and heavy smoking were least prevalent among those who felt that religion was very important in their lives and increased uniformly as the self-reported importance of religion lessened. Similarly, adolescent smokers in the 1989 TAPS were more likely to report that they rarely or never attended religious services (54 percent) than were never smokers (29 percent) (Allen et al. 1993).

TAPS also analyzed smoking by dropout status. Respondents who had left school before graduating were more than twice as likely to report smoking in the past week as were those who currently attended or had graduated from high school (43 vs. 17 percent) (CDC 1991a). Female high school students and graduates were about as likely as their male counterparts to have smoked in the past week (17 vs. 18 percent). Female dropouts, however,

Table 5. Percentage of young people who report frequent or heavy use of cigarettes, by gender, race/Hispanic origin, age/grade, and region, Teenage Attitudes and Practices Survey (TAPS), National Household Surveys on Drug Abuse (NHSDA), Monitoring the Future Project (MTFP), Youth Risk Behavior Survey (YRBS), United States, 1989, 1991, 1992

Characteristic	1989 TAPS*	1991 NHSDA†	1992 MTFP‡§	1991 YRBSΔ
Measure of use	Frequent	Heavy	Heavy	Frequent
Overall	8.1	6.6	10.0	12.7
Gender				
Male	8.4	6.9	10.4	13.0
Female	7.7	6.2	9.2	12.4
Race/Hispanic origin				
White, non-Hispanic	10.1	7.9	12.0	15.4
Male	10.5	8.1	12.2	15.0
Female	9.7	7.6	11.6	15.8
Black, non-Hispanic	1.9	2.8	1.6	3.1
Male	2.8	3.7	2.4	4.5
Female	1.0	1.8	0.9	1.9
Hispanic	4.4	3.0	NA†	6.8
Male	4.0	2.4		8.0
Female	4.9	3.6		5.7
Age/grade				
12–14 years	1.8	1.2		
15–16 years	8.3	6.5		
17–18 years	16.7	14.4		
8th grade			2.9	
9th grade				8.4
10th grade			6.0	11.3
11th grade				15.6
12th grade			10.0	15.6
Region				
Northeast	8.7	7.7	11.1	12.1
North Central	9.1	7.1	10.9	18.9
South	7.3	6.2	10.2	10.5
West	7.6	5.7	6.8	9.0

Sources: **1989 TAPS:** Centers for Disease Control and Prevention (CDC), Office on Smoking and Health (OSH) (unpublished data); **1991 NHSDA:** CDC, OSH (unpublished data); **1992 MTFP:** Johnston, O'Malley, Bachman (in press); Institute for Social Research, University of Michigan (unpublished data); **1991 YRBS:** CDC (1992c); CDC, Division of Adolescent and School Health (unpublished data).

*1989 TAPS, aged 12–18 years. Based on responses to the questions, "Have you ever smoked a cigarette?" and "Think about the last 30 days. On how many of these days did you smoke?" Those who had smoked on 20 or more of the previous 30 days were classified as frequent smokers.

†1991 NHSDA, aged 12–18 years. Based on response to the question, "How many cigarettes have you smoked per day, on the average, during the past 30 days?" Respondents who reported smoking about one-half pack a day (6–15 cigarettes) or more were classified as heavy smokers.

‡1992 MTFP survey. Based on response to the question, "How frequently have you smoked cigarettes during the last 30 days?" Respondents who reported smoking about one-half pack per day or more were classified as heavy smokers.

§With the exception of data for 8th- and 10th-grade students, all other data points for the MTFP survey reflect estimates for high school seniors.

Δ1991 YRBS, grades 9–12. Based on response to the question, "During the past 30 days, on how many days did you smoke cigarettes?" Those who had smoked on 20 or more of the previous 30 days were classified as frequent smokers.

†NA = Not available.

Table 6. Prevalence (%) of cigarette smoking among high school seniors, by various sociodemographic risk factors, Monitoring the Future Project, United States, 1985–1989

Sociodemographic risk factor	N (weighted)	Smoked during past month	Smoked \geq 10 cigarettes/day
Household structure			
Lives with both parents	58,100	28.3	10.3
Lives with father only	2,657	35.4	16.3
Lives with mother only	13,955	29.5	12.2
Lives alone	547	47.2	28.3
Other	5,783	34.4	17.8
Population density of locale in which respondent grew up			
Farm	4,445	32.5	12.3
Country	9,438	30.8	12.4
Small city	23,837	28.9	11.0
Medium-sized city or suburb	16,096	29.3	10.9
Large city or suburb	12,504	28.3	10.8
Very large city or suburb	7,612	25.9	8.9
Self-reported overall academic performance			
Above average	24,640	21.6	6.6
Slightly above average	18,688	28.0	9.7
Average	28,609	34.0	14.2
Below average	5,652	40.6	20.7
Plans to complete four years of college	50,364	23.9	6.9
Does not plan to complete four years of college	25,379	39.1	19.5
Plans to enter the armed forces			
Male	8,317	31.2	13.7
Female	2,644	30.4	12.3
Does not plan to enter the armed forces			
Male	25,621	26.1	10.0
Female	34,669	30.1	11.0
Importance of religion			
Very important	20,637	19.2	5.9
Important	25,166	29.5	10.5
Not/somewhat important	33,104	35.1	15.2

Source: Centers for Disease Control and Prevention, Office on Smoking and Health (unpublished data).

were less likely to have smoked than male dropouts (33 vs. 52 percent). White high school students and graduates were more likely than their black counterparts to have smoked in the past week (19 vs. 6 percent). White dropouts were also more likely to have smoked than were black dropouts (46 vs. 17 percent). Data on past-month smoking for 16- through 18-year-old high school seniors and similar-aged youth who reported that they had dropped out of school are available from the NHSDA (Kopstein and Roth 1993). About 28 percent of white students and 72 percent of white dropouts were past-month smokers, and 7 percent of black students and 30 percent of black dropouts were past-month smokers. Among Hispanic 16- through 18-year-olds, however, past-month smoking prevalence was less divergent between students (25 percent) and dropouts (27 percent). Pirie, Murray, and Luepker (1988), using surveys conducted in Minnesota, also reported a higher prevalence of smoking among dropouts.

Age or Grade When Smoking Begins

Smoking initiation at a young age increases the subsequent risk of heavy smoking (Escobedo et al. 1993; Taioli and Wynder 1991) and of smoking-attributable mortality (USDHHS 1989b). As is discussed in detail in Chapter 4 (see "Developmental Stages of Smoking"), smoking initiation is a complex process that can occur over a number of years. The present analysis examined two points in this process: the age a person first tries a cigarette, and the age a person begins smoking daily.

Because some initiation occurs after the adolescent years, the analysis began with self-reported data recalled by adults in the 1991 NHSDA (Table 7). The analysis was further restricted to adults aged 30 through 39 because virtually all initiation occurs before the age of 30 (CDC 1991b; SAMHSA, unpublished data) and because virtually all of the increased mortality that results from cigarette smoking occurs after the age of 40 (National Center for Health Statistics [NCHS] 1992a;

Table 7. Cumulative percentages of recalled age at which a respondent first tried a cigarette and began smoking daily, among persons aged 30–39, National Household Surveys on Drug Abuse, United States, 1991

Age (years)	All persons*		Persons who had ever tried a cigarette	Persons who had ever smoked daily	
	First tried a cigarette	Began smoking daily	First tried a cigarette	First tried a cigarette	Began smoking daily
< 12	14.1	0.9	18.0	15.6	1.9
< 14	29.7	3.9	38.0	36.7	8.0
< 16	48.2	12.2	61.9	62.2	24.9
< 18	63.7	26.0	81.6	81.9	53.0
≤ 18	68.8	34.9	88.2	89.0	71.2
< 20	71.0	37.8	91.0	91.3	77.0
< 25	76.6	46.5	98.2	98.4	94.8
< 30	77.4	48.1	99.3	99.4	98.1
≤ 39	78.0	49.0	100.0	100.0	100.0
Never smoked	100.0	100.0	NA [†]	NA	NA
Mean age	NA	NA	14.5	14.6	17.7

Source: Centers for Disease Control and Prevention, Office on Smoking and Health (unpublished data).

*All persons (N = 6,388).

†NA = Not applicable.

Table 8. Age or grade when respondents first tried a cigarette, Teenage Attitudes and Practices Survey (TAPS), National Household Surveys on Drug Abuse (NHSDA), Monitoring the Future Project (MTFP), Youth Risk Behavior Survey (YRBS), United States, 1989, 1991

Age/grade*	TAPS [†] %	NHSDA [‡] %	MTFP [§] %	YRBS [¶] %
≤ 12 years/≤ grade 6	10.1	25.2	18.5	19.2
13–14 years/grades 7–8	11.4	14.5	21.6	17.7
15–16 years/grades 9–10	22.0	16.6	14.9	15.9
> 16 years/> grade 10	8.2	3.9	5.3	5.7
Never smoked	48.3	39.9	39.8	41.4

Sources: **1989 TAPS:** Centers for Disease Control and Prevention (CDC), Office on Smoking and Health (OSH) (unpublished data); **1991 NHSDA:** CDC, OSH (unpublished data); **1991 MTFP:** Institute for Social Research, University of Michigan (unpublished data); **1991 YRBS:** CDC, Division of Adolescent and School Health (unpublished data).

*In TAPS, the NHSDA, and the YRBS, respondents reported the age at which they had first smoked; in the MTFP, respondents reported the grade in which they first smoked.

[†]Includes 17- and 18-year-old respondents to the 1989 TAPS who had completed the 11th grade and who still attended school. Response categories were constructed using the questions, "Have you ever smoked a cigarette?" and "How old were you when you smoked your first whole cigarette?" (N = 687).

[‡]Includes respondents to the 1991 NHSDA between the ages of 17 and 18 years who had completed the 11th grade and responded to the question, "About how old were you when you first tried a cigarette?" (N = 979).

[§]Includes high school senior respondents to the 1991 MTFP survey who responded to the question, "When if ever did you first do each of the following things . . . Smoke your first cigarette?" (N [weighted] = 2,012).

[¶]Includes 12th-grade respondents to the 1991 YRBS who responded to the question, "How old were you when you smoked a whole cigarette for the first time?" (N = 3,127).

Table 9. Age or grade when respondents began smoking daily, National Household Surveys on Drug Abuse (NHSDA), Monitoring the Future Project (MTFP), Youth Risk Behavior Survey (YRBS), United States, 1991

Age/grade*	NHSDA [†] %	MTFP [‡] %	YRBS [§] %
≤ 12 years/≤ grade 6	3.3	2.3	3.3
13–14 years/grades 7–8	4.0	8.5	6.1
15–16 years/grades 9–10	10.4	11.9	10.2
> 16 years/> grade 10	4.6	6.0	4.5
Never smoked daily	77.5	71.2	76.0

Sources: **1991 NHSDA:** Centers for Disease Control and Prevention (CDC), Office on Smoking and Health (unpublished data); **1991 MTFP:** Institute for Social Research, University of Michigan (unpublished data); **1991 YRBS:** CDC, Division of Adolescent and School Health (unpublished data).

*In the NHSDA and the YRBS, respondents reported the age at which they had begun smoking daily; in the MTFP, respondents reported the grade in which they had begun smoking daily.

[†]Includes 17- and 18-year-old respondents to the 1991 NHSDA who had completed the 11th grade who responded to the question, "About how old were you when you first started smoking daily?" (N = 959).

[‡]Includes high school senior respondents to the 1991 MTFP survey who responded to the question, "When, if ever, did you first do each of the following things . . . Smoke cigarettes on a daily basis?" (N [wtd.] = 2,074).

[§]Includes 12th-grade respondents to the 1991 YRBS who responded to the question, "How old were you when you first started smoking cigarettes regularly? (at least one cigarette every day for 30 days)" (N = 3,074).